

The Xtal Set Society Newsletter

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Musings From a Long Winter by Dan Petersen - W7OIL

As I write this the signs of spring are popping up everywhere. The daffodils have been daffing, the tulips are tuling and the clematis is - clemming(?). I won't mention what the bleeding heart plant is doing! The streets are wet (In the Northwest? DUH!) but winter is losing its grip. I read where things were, um, snowy in the Northeast. One report said the rescue services are hoping to get snow removal gear into downtown Boston by July. The fire departments had to chip the dogs away from the fire hydrants before they could fight a fire. Well, not THAT bad but the word "snow" makes north-easterners turn funny colors right now. On the other hand, they had to truck snow IN for the Alaska Iditarod race. And now it's "Climate Change" because the eco-goons find it hard to say "Global Warming" when they are standing armpit deep in snow. Go figure.

So what does this have to do with crystal sets? Well...how about ANTENNA SEASON! Three years ago I moved from radio Nirvana to radio Purgatory, acreage to a nice retirement village with antenna restrictions and "postage stamp" lots. Radio Nirvana had such a low man-made noise level and acreage that I could hear atmo-

spheric noise on a crystal set with NO amplification using my "RMS Titanic" antenna. Now in the Urban Jungle I am lucky to hear myself think with all the TV's, light dimmers, 279,623 switching power supplies for laptops and other sundry necessities of life these days. No outside antennas. I do however, have a flagpole in the back "yard" (allowable) that by some fantastic coincidence is resonant at the 20 meter ham band. I also have snuck a 60-foot wire antenna up along the ridge of the roof. The 40-meter loop (experimental) in the sun-porch will not be discussed here. The wire antenna across the roofline has an associated ground rod right outside my man-cave. It is this antenna that I wish to center my discussion around.

Knowing the restrictions of my wire antenna I have tried to maximize every aspect of its design. I then wished to determine the parameters of the antenna for maximum efficiency.

Maximize the Situation, Minimize the Visibility

There are a few rules-of-thumb that can apply here. Longer is better, higher is better and longer AND higher is best. Now I have to hide my clandestine operations from whom I call the "Yard-Nazis". In grade-school these finks were called "tattle-tales", those kids that would sell you down the river for the chance to feel smug. The yard-nazis haven't grown up since grade-school. Every "Geezer Farm" (retirement community) has at least one mated pair of yard-nazis. So the antenna has to be as non-visible as possible. I used #22 stranded wire with a white teflon insulation. Why teflon? Because I had a big roll of it. Insulators can be a problem as they can be seen fairly easily. Use clear "Lexan" and sand it dull so it will not flash in the sunlight. It also transmits light from

whatever color is behind it. See Figure 1. Grey in this climate is a good camouflage. My weather station anemometer and wind-vane on the peak

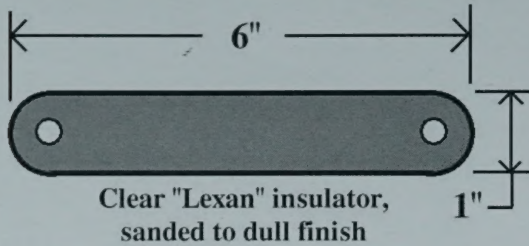


Figure 1

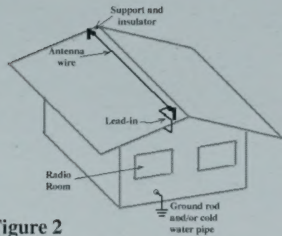


Figure 2

of the roof are painted flat grey and I have had no complaints. Placing the antenna supports so that the antenna is about a foot above the shingles and about two feet down from the peak of the roof. This way the wire blends in with the roof and is not silhouetted against the sky. Figure 2 shows basically the arrangement. The lead-in I use is a piece of #8 bare copper wire bent so it bends around the roof and to the porcelain feed-through in the outside wall. When asked about it I tell them it is my "lightning protection" which is not far from the truth. I do keep the antenna grounded when not in use. So now I have an antenna that 90% of experimenters can expect to put up.

Uh, oh – Time to get Technical

In determining the basic parameters you need to make measurements of the antenna resonance and reactance. Both of these parameters can be found with a grid-dip oscillator (GDO) and some mathematics. You can get an idea of the antenna resonance by adding the antenna plus the lead-in length in feet and dividing 234 by the combined antenna and lead-in length. In my case the $Aw + Li = 62$ feet. Plug that into the equation and

I get a resonance of 3.77 MHz. Now I take the grid-dip oscillator, wrap a couple of turns around the sensor coil and connect the alligator clips to antenna and ground. I plugged in the appropriate coil and tuned the GDO. Voila! Resonance at 3.91 MHz. Comparing the two means it's "close enough for government work". Since we want to use the antenna (usually) at Broadcast Band frequencies (540-1700 KHz) we now know that the reactance is capacitive – it "looks" like a capacitor. So to tune the antenna to BCB resonance we need to add an inductance. OK – give it my best WAG (wild agreeable guess) and use a crystal set inductor. The one I used has an inductance of 243 microhenries (uH). But wait! There's more!! Large value inductances, especially solenoid-wound ones have a distributed capacitance. At some point in the spectrum they will resonate all by themselves. This can be found with the trusty GDO – loosely couple the GDO to the coil and search for a resonance (a "dip"). Voila again! This coil resonates at 5.5 MHz. I used a spreadsheet I call "Professor Coyle" to determine the capacitance having a known inductance. The capacitance comes out to 3.7 picofarads (pF). Not very much but still one to keep an eye on.

To determine the capacitance of the antenna, at least in the frequency range of interest consult Figure 4 for details. Now as I look for a resonance I finally find one at 860 KHz. Professor Coyle tells me that the total capacitance at C_n is 152 pF. Subtracting that pesky self resonant capacitance of 3.7 pF I get 147.3 pF, giving me the capacitance, at least at that frequency. This 860 KHz

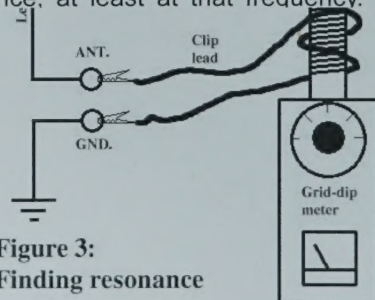


Figure 3:
Finding resonance

reading is familiar to me. I have a 50kw flame-thrower at 860 KHz about 7 miles from here. What would happen if I connected the coil across the antenna and hitched a diode detector and head-phone to it? I connected the coil to the antenna and ground, connected a 1N5711 schottky diode to the antenna side and a pair of 4800 ohm magnetic headphones to the other side of the diode and ground. Result? KPAM-860 roars in like a Kansas tornado. The antenna "Cn" in cahoots with the inductor tune in the crock-jocks very well. I can hear a couple other stations faintly in the background. Note: A modern schottky diode like the 1N5711 is at least as good as the tried and true germanium diode such as the 1N34. You can see in Figure 4 that I also tried a catwhisker detector with an Australian "Brakunga" iron pyrite. Note the neat layout of the receiver. Don't be jealous! Listening to a single talk station would be great if I wanted to listen to verbal bovine fertilizer 24/7. The idea here is to resonate that skyhook on the roof. If we are going to make an inductor that will resonate from 530 to 1700 KHz the math tells us that we need an inductor with a range of 613 uH at 530 KHz to 60 uH at 1700KHz. Quite a spread.

The Loading Coil

Calculations by Professor Coyle indicate that a piece of 4" PVC pipe 5" in length with 88 turns of #18 enameled wire (97 feet) will give me a coil of 628 uH. I am using a large diameter wire to reduce distributed capacitance. I plan to make it in the fashion of a "slider" coil with a sliding tap. The intent is to make a "loose coupler" set of coils

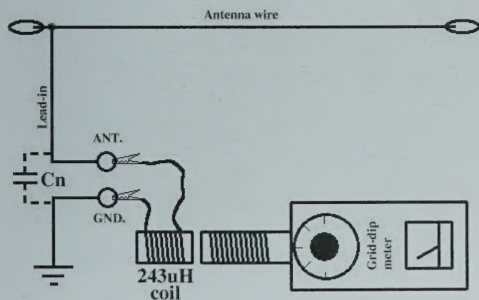


Figure 4:
Antenna capacitance

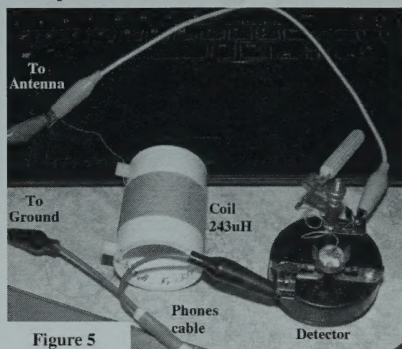
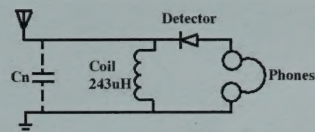


Figure 5

with the crystal set tuning coil movable inside the loading coil.

I ran out of #18 wire at 77 turns. Professor Coyle tells me that the inductance will be 524 uH. I measured it with a precision 300pF capacitor in parallel and GDO dipped it at 403 KHz. Inductance? 527 uH! The "Prof" is usually really close. So how close was I with the coil connected to the antenna? Supposing the antenna capacitance is 147 pF and the coil is 527 uH with a distributed capacitance of 4.2 pF. The Prof says 560 KHz. The GDO dipped it at 570 KHz!

Future Plans

I plan to build a slider onto this coil so I can set the inductance depending on the frequency. Then I will build a crystal set that will couple to the antenna tuning coil via a loose coupler arrangement. Now I do not believe I have ever left my reader dangling at the end of an article but the plans I have will easily fill another article. So stay tuned!

So, who or what is this "Professor Coyle"? "He" is an Excel spreadsheet that aids in coil calculations and other pesky mathematical problems. I designed it about 2003 or so and it has been a godsend. There is also an HTML version at <http://www.crystalradio.net>. Darryl Boyd was kind enough to convert it to HTML. I can send you the latest spreadsheet version via email.

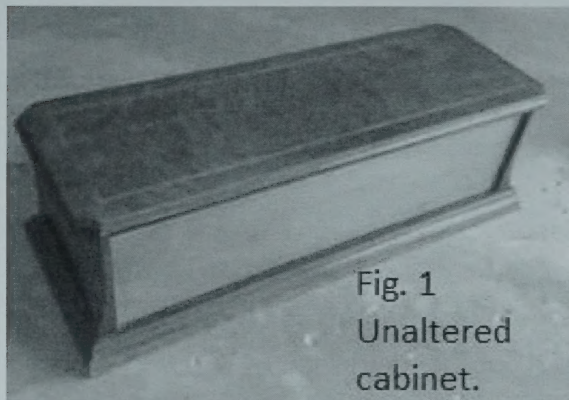
Keep experimenting!

email: dan.w7oil@gmail.com

A Really Big Crystal Radio

by Stan Kaplan, WB9RQR and Bill Howe, KA9WRL

A few years ago, one of us (Bill Howe) ran across an interesting radio cabinet at a yard sale in Grafton, Wisconsin. It was intriguing because the large box (about 10" high X 12" deep X 34 inches wide!) was formally a Howard Radio model from the 1920's. It was completely empty, save the metal logo plate inside the top, hinged lid. Fig. 1 shows a birds-eye view of the unaltered cabinet.



Someone had removed the radio chassis inside which contained the variable capacitors, transformer, tubes, batteries and all the wiring. Not only that, but the radio's large slate faceplate and all the knobs were gone as well. The faceplate had been replaced by a plain, handcrafted teak board, stained lightly to match the rest of the cabinet.

Bill suspected that the person who modified the Howard Radio cabinet had plans to either build a more modern radio inside that cabinet, or just make a nifty-looking storage box for whatever. Anyway, the price tag was just \$5, so Bill snatched it up quickly, with no immediate plans for the box.

After storing that beautiful "project box" for a few weeks, Bill finally came up with a plan. Let's make it a radio again, but this time it'll be a crystal radio perhaps the world's LARGEST crystal radio.

Because Bill hadn't built anything of this magnitude before, and had almost no experience in winding

large capacitance coils, he decided to contact a fellow member of our Ozaukee Radio Club, Stan Kaplan. Stan was very adept at winding a wide variety of coils and had built several crystal radios throughout the years, plus he was also a member of the Xtal Set Society. Stan welcomed the cooperative project with open arms.

It was to be a "Winter Project", but Stan wasted no time in winding the coils and filling that cavernous container with a myriad of wonderful and colorful gadgets, making it almost too pretty to close the lid! With some additional staining on the faceplate and the addition of some antique dials and knobs that Bill had been saving for something like this, the radio was ready for its debut at our next mid-winter ham radio club meeting.

Our design for the electronics is shown in Fig. 2. Two rook-wound coils (L1 and L2) were mounted so as to be moveable with respect to each other, permitting an almost infinite range of coupling in nearly half of the huge cabinet. Nothing fancy here – two PVC pipes penetrated openings in the windings and served as guides to hand-move the coils as desired. This can be seen in Fig. 3 – the top PVC pipe is painted black and is clearly visible. Indicators made of red electrical tape circle the pipe and provide convenient logging markers for reproducing the coil settings. C₁ is mounted inside the extreme left of the cabinet. Its knob is visible on the left side of the front panel. C₂, the main tuning capacitor, is mounted near the center of the cabinet. That is the knob with the dial and pointer.

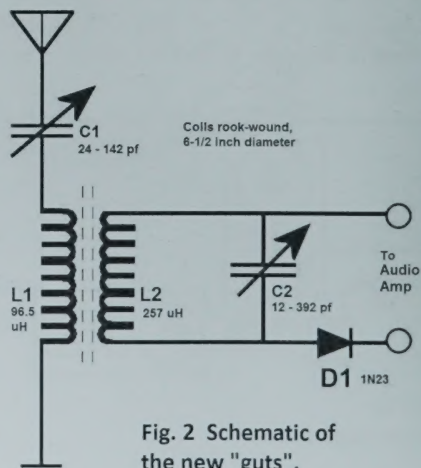
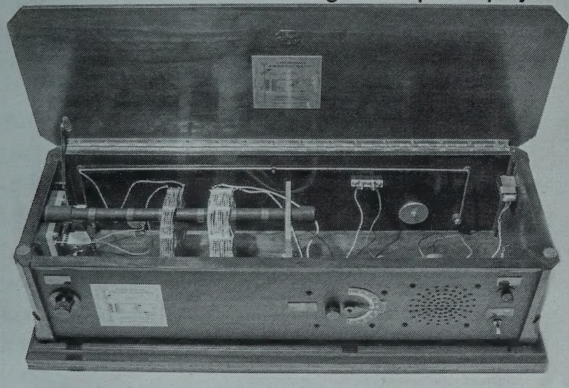


Fig. 2 Schematic of the new "guts".

Although “purists” would use no battery driven parts in a crystal radio, we wanted to make the unit more conducive for demonstrations to large groups. Bill had a small, transistorized audio amplifier and a high quality 4-inch permanent magnet speaker in his parts box, so we agreed to add those components. The 9-volt battery that powers the amp can be seen in the back right corner of Fig. 3, with wires leading to the amp mounted near the front panel. An on/off switch and volume control can be seen on the right of the front panel, next to the panel perforations we added for the speaker.

Fig. 3 Completed project.



The layout of the controls can be seen best in Fig. 4. A brass plate etched with the circuit is near the knob for C_1 , the antenna tuning capacitor. Finally, the original Howard Radio Company logo is shown enlarged in Fig. 5; it is also just visible in Fig. 3 on the inside of the lid above another brass plate showing the circuit diagram.

Fig. 4 Front panel view.

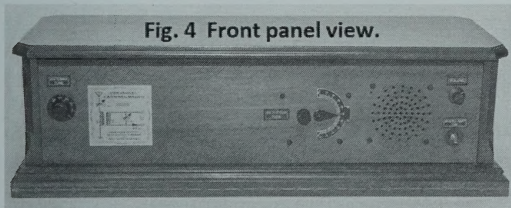
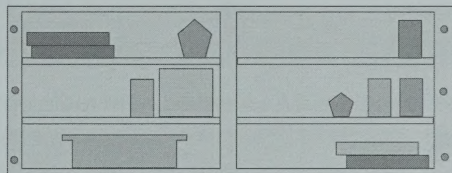


Fig. 5 Original logo, still inside the lid.

So, does it work? You bet! With a hunk of wire for an antenna and another for a ground (connected to the metal plate screw of a wall outlet), we invariably pull in stations from local and some DX stations as well. Great fun, but surely not compact and tiny!!!



“Grampaw! Why don’t the kitchen shelves have any doors” ?

“Cause nobody ever closed them, so I used them for my ham bench,” Gramps!



WØXI

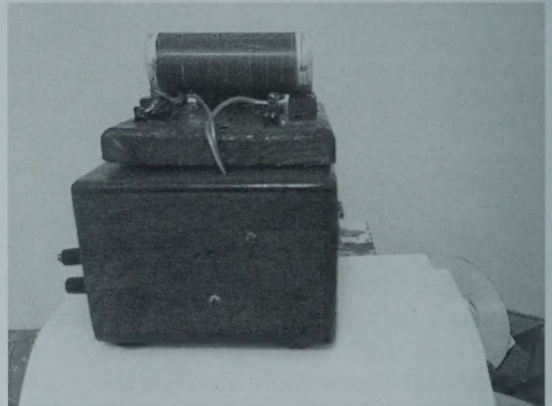
Bill Michna Radio

Thanks for taking interest in my cigar box radio. Sorry about missing any deadline that the society had but as I said I just received the news letter on Monday. I had just finish what you see in my photo not even knowing that you were wanting to hold a contest. so I took a shot in the dark thinking that I had nothing to lose and e mailed my picture.

I started to build this radio inside the small cedar box. I mounted a small adjustable capacitor with a knob for tuning in the front of the radio, along with 2 binding posts for antenna and ground connection. In the upper left hand corner there is a 1/4 inch phone jack plug for the high impedance ear phones. The cat whisker sits on top of the box as does the 1 1/4 inch diameter coil with about 100 turns of number 24 magnet wire. I devised an antenna to test my radio.

I built this so my grandson would have an interest in electronics. I talked him into building an oatmeal box radio for an up-coming science fair at his school.

For the record I am A Licensed ham radio operator KB9ACI and a retired sales fire protection engineer. During the past 60 years or so I have built about 30 or so crystal radios .most worked but a few did not. thanks Bill Michna

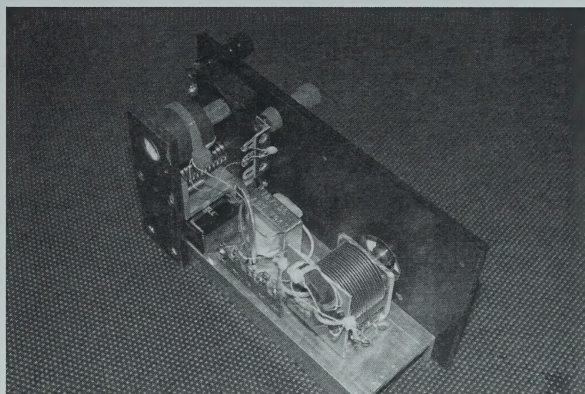
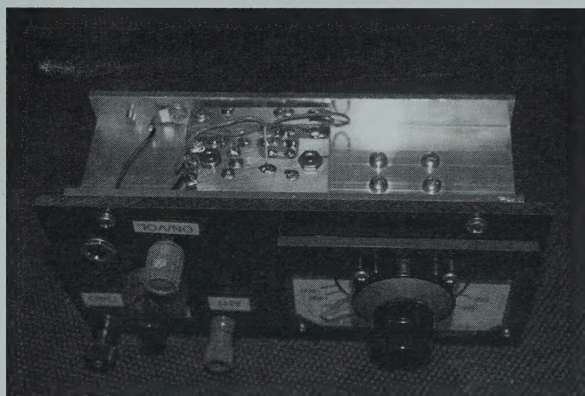
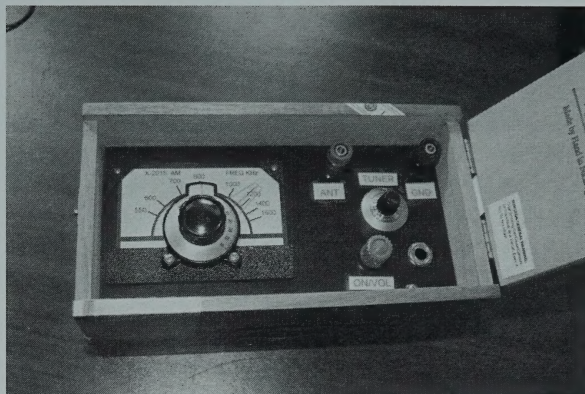


Carl Wick Radio

Please find attached a picture of my entry - two if I can get away with it (they are pretty big)! You will see the radio fits in the box I got from you - a very nice cigar box! The only modification to the box was to put some wooden posts in the corners to support the faceplate of the radio.

The radio itself uses a single Shottky Diode detector and contains a home-brew two transistor amplifier - situated underneath since I'm wearing hearing aids and can't hear well enough without amplification.

It has a single tuned circuit consisting of a coil wound of Litz wire on a '61 toroid. The antenna tuner consists of a home built device that inserts a ferrite rod into a loopstick coil; the coil is inside of a ferrite bead. The device will change inductance from about 70 μH to over 1 mH. It does very well tuning my vertical Ham band antenna that I used to develop the radio. The faceplate is a piece of bakelite I had and the main dial is a modification of a dial I had laying around. The only thing I'm not happy about is the use of paper labels - I tried making some decals, but could not come up with a color from my printers that you could see against the bakelite - will continue to search for a better answer. The amplifier, by the way, is a little two 2n3904 transistor AC coupled to a transistor output transformer that can easily drive headphones or a small speaker. I 'etched' a small circuit board with a Dremel tool - not enough time to make a 'real' one! I will send a much more complete description if you are interested. Had great fun making this and it works very well!



Xtal Corner: Member Correspondence

From: Richard Felton

Dear Patricia, I hope you are well. I taped together three ferrite rods and wound on eight and a half turns of connecting wire. It tunes well to the 49 m band. I have picked up China, Vietnam and a Spanish station so far. Hope this is of interest to your readers. Luv Richard Felton.

Richard,

I like your idea. It might be fun to try two of these wherein each rod set is perpendicular to the other. That way one might be able to receive a station while listening with each radio in one ear. Call it a diversity crystal receiver. I may give that a try. What does the rest of your circuit look like and did you add any audio amplification?

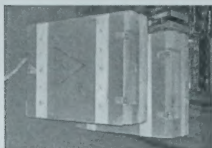
Phil, W0XI.

Good Morning Crystal Queen !

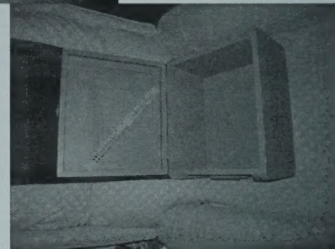
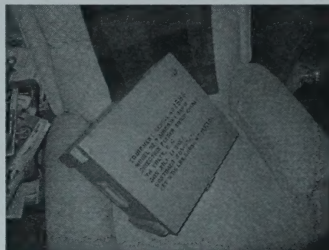
How goes? Hope all is well and you are staying warm. Here in Iowa it is rather chilly. A friend in Finland sent me a pix. It warmed up so he went out and dangled his feet in the water. **Air temp was a balmy twenty below zero Fahrenheit !**



I went to a gun show this weekend and picked up some wooden munition boxes that will be used as cases for some radio builds currently under way in my basement (pix attached).



A thought on something a bit modern yet old-looking. Since the plate voltage on a tube radio is moderately high, people might accidentally juice themselves if they touched something exposed on a breadboarded radio. If the radio was designed around a solid state device like a 2N5484 JFET or even a MK484 IC, there could be an OCTAL or LOCTAL socket on a breadboard. Then, a matching coil form with plug would contain the heart of the detector circuitry. The coil form detector with PCB attached would then be sheathed in a simulated yet plastic "tube" ----> let us say something resembling an O1A.



Done up with either old OEM or simulated old components on a bread board, this could make for a STEAMPUNK radio that conveniently uses low voltage. Some quick WEB SURFING gave me a few pix. Take care, Ron Sindric

Hi Patricia and Phil,

Thanks for your email reminding me about renewing. I must have missed the red stamp on the last issue. A check is on its way to your POB.

I'd been meaning to reply to Phil's nice email last year, and then the year got away from us. Phil is quite right guessing I'm probably EE or physics.

Actually PhD physics in the mid 1970's from Boulder CO. Real pointy headed theoretical physics at that time. Migrated over the years into computers working at places like Microsoft in the early days. Been running our own company since 1986 building A/D converter type equipment. Mostly selling to seismic interests one way or another. I have a long history with that field.

If you'd like to see some of what we do, go to www.symres.com. High precision A/D design is its own little specialty.

But what I really am ... is a kid who grew up in California going to surplus shops and hanging out with hams. Still one of my greatest thrills in life was building a xtal radio in elementary school. I'm sure you hear that often, but that was it for me, I knew what I had to do. Hope your work has generated many such stories. Never got a ham license, was way too carried away with how it all worked.

As a physicist, even if pointy headed, I cannot tell you how pleasing it was a few years back when you ran a few articles on negative resistance. That was closer to the core spirit of the subject than anything I read about big govt money in Physics Today. You should not be surprised that you do well with EE and physics depts. There are still a few of us out there.

Best regards, Kip Wyss Symmetric Research

From Anthony Dunn:

Will a brass screw load my xtal coil?

"My latest radio has a spider-web coil which is mounted by a brass screw in the center. A friend of mine is of the opinion that the conductive brass screw, although non-ferric, is introducing unwanted loading to the coil. What are your thoughts on that? Thanks!"

Two thoughts: 1) depends upon the size of the screw and 2) simply replace the brass screw with a nylon one. We sell small assortments of nylon hardware; see our website, www.midnightscience.com

Many sets have used a metal rod to tune the main coil of a set and paralleled that with a fixed capacitor. As the metal rod is pushed into the

inside of the coil, the inductance of the coil, over all, is reduced. It is true that the Q (sharpness) of the tuned circuit is reduced too; and as such the tuning selectivity is reduced. One thing you can do to check your coil and brass screw is to tune in a station, then replace the brass screw with a nylon or plastic screw and then check if the station is still tuned in. If it is, the brass isn't affecting the circuit much. If it requires you to retune the set using the variable capacitor, but only by a small fraction of rotating the knob, then the effect of the brass screw is only slight (so don't worry about it). Nice to hear from you. Phil, WØXI.

Thanks Phil! I'll try the experiment as soon as my nylon hardware gets here. (Had a hunch, so I went ahead and ordered some from you.)
Anthony L Dunn

From Dean Lewis, W9WGV

Folks:

Four questions, if you wouldn't mind:

1. what's the difference between the Infinite Impedance Detector and the JFET Detector? Which works best?

The infinite detector preserves a bit more audio gain and fidelity.

2. Are either of them frequency-sensitive? (I sometimes assemble xtal sets for shortwave frequencies.)

No. However, their high input impedance preserves the bandwidth of your LC circuit for HF.

3. What's the capacitance range of the trimmer cap used in your XS-402 Little Wonder Crystal Radio Kit?

50 to 200 PF

4. May I purchase a couple of these trimmer caps?

Tnx es vy 73;

5-4-15

Salutations Crystal Queen !

It is darn cold around me. So, I've been spending lots of time at home. My number one project is to finish the Iowa motorcycling magazine article including edited photographs that I am working on.

I take a break and work a bit on some of my stylized "Olde Aetherwave Attractores". Besides my various Crystal Radio Projects, I have started marshalling materials to build some portable / travel battery-powered REGEN and SUPER-REGEN TUBE RADIOS. These radios will be crafted into "Olde-Styled" small suitcases and a few of the military equipment cases I have lying around (*see attached pix*). My bird-house-rock-et-radios are lurching ahead slowly. The pace will pick up when my magazine article is in my editor's hands. As with the cardboard coil forms, I am pre-treating the wooden birdhouses with a wash of carpenter's glue and wood filler where needed before sanding and either staining or painting. More pix to come

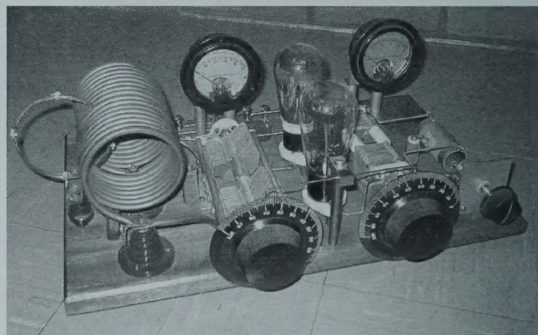
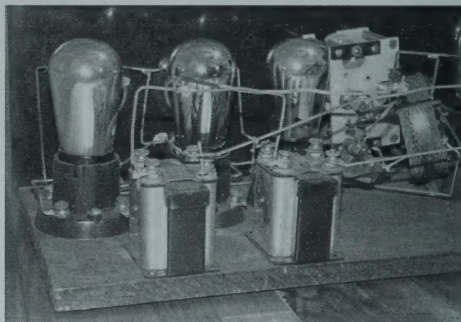
Yesterday evening after an abortive attempt to hand wind a coil, I decided to put a three strings of double-sticky foam-centered tape on the paper coil form. The paper / cardboard coil forms I am using are rigidized by pre-treating them with carpenter's wood glue. This seemed to do the trick. Keep in mind that I am all thumbs and you would have had a good laugh as my nearly-completed coil slipped out of my hands, went rolling along the floor and auto-unwound.

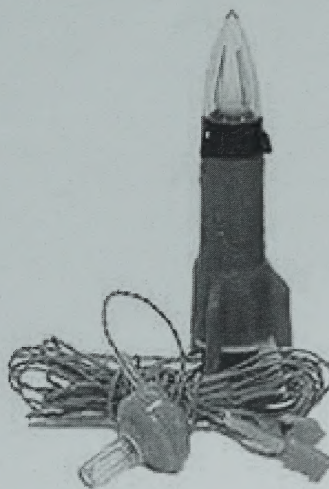
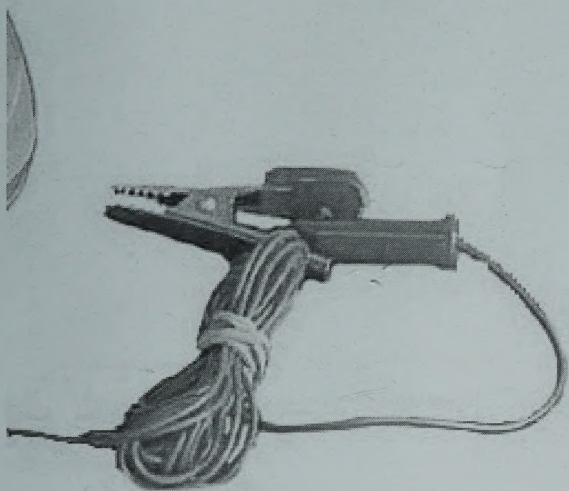
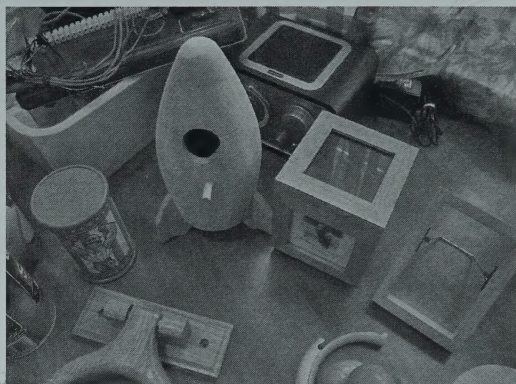
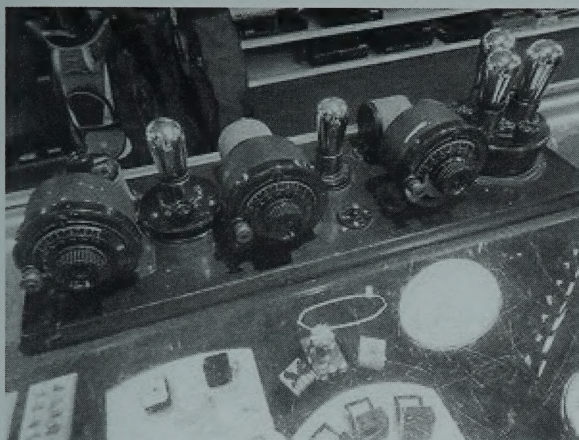
Once the coil was wound, I secured the first and last turns on the coil form along with the twists that make up the coil's loop taps with an adhesive.

Are you familiar with a product called WALTHER'S "GOO" . It is sort of rubber cement but on steroids. Heck, the stuff is not only waterproof, but gasoline and oil proof to boot !

<http://www.waltthers.com/exec/productinfo/904-299>

My next little tinkering will be to use a few beads of GOO rather than the foam-centered double sticky tape. Well, have to get back to image editing. I took about 400 pix with my NIKON DSLR and have done the first culling down to a key 88 to clean up. More work to do. Ron Sindric





Editor: As you can see, Ron is a very busy fellow.

e-mail: xtalset@sunflower.com

We are dedicated to once again building and experimenting with radio electronics, often—but not always—through the use of the crystal set, the basis for most modern day radio apparatus. This newsletter helps support our goal of producing excellent quality technical books that encourage learning and building. To join the society and receive one year of the bi-monthly newsletter, remit \$14.95 to The Xtal Set Society. Canadians, please remit US \$15.95. Outside the US and Canada please remit US \$21.95.

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Oat Box Radio Pack 1

Build an inexpensive radio out of an oat meal box. The pack includes 1 Spool (100 feet) #24 wire, 1 IN34 Diode, 1 100 pf Capacitor, 1 47K Resistor, 3 alligator clips, 1 ceramic, hi impedance ear piece, 6-32 by 1/2 machine screws, 6-32 nuts, 5 #6 solder lugs -- you provide the box (eat the oatmeal, it's good for you!) and an antenna. The plans for this radio are on our website at www.midnightscience.com. Great for classes and scouting -- easy for kids to put together. If you need antenna wire, then order the Oatbox Pack 2.

Cat# OB1 \$14.95 Oat Box Radio
Pack 2 This has all the parts of our

OB1 kit, but includes an extra roll of wire for the antenna.
Cat# OB2 \$19.95

The Little Wonder Crystal Radio Kit

Our "Little Wonder" is a super starter kit for kids and beginning adult builders! It tunes the entire broadcast band. The extra large solder pads make it easy for beginning builders to have a successful first radio. There are only a few solder joints, and the pads are spread out making it clean and simple to assemble. The "Little Wonder" was designed especially for the XSS by our founder, Grampa Phil, WØXI. We tried to combine everything we've learned about building radios with beginners and kids to create a radio that everyone can build the first time. There is no coil to wind, a high resonant frequency molded choke has been used in place of the coil. A nice photo diagram is included showing all the parts and their placement on the printed circuit board. (PCB) This radio is perfect for parents and grandparents to build with kids. It is also priced right for classroom use, and can be used to teach basic radio theory, soldering, and handling of electronic parts and PCB's. Kit includes a high impedance crystal earplug. A great little kit; you've got to have one! Cat# XS402 \$19.95

ORDER FORM (5/2013)					Cat#	Qty	Price
Subscription The Xtal Set Society Newsletter 1 year							14.95
Subscription Canadian 1 year (in US dollars)							15.95
Subscription International 1 year (in US dollars)							21.95
Shipping (delete if subscription ONLY) 1st Class mail 1-2 items \$5.95, 3-4 items \$7.95, 5 or more \$8.95							
{International orders specify surface or air-mail, shipping will be determined on a per order basis. please use VISA/MC only}							
TOTAL Kansas residents please add appropriate sales tax							
We accept checks, money orders, or VISA/MC							
VISA MC Card#					EXP		
Signature:							
Name:							
Address:							
City State/Zip code:							
Phone							
E-mail:							
Orders are filled promptly, but allow 2-3 weeks for delivery							

